patible with the elimination of "flour." The following table is the average of three determinations:—

	Percentage of voids.
Passing ¾-in. and retained on ⅝-in.	48.2
⅜-in. to ½-in.	44.5
½-in. to ⅜-in.	43.4
⅜-in. to ¼-in.	42.9
¼-in. to ⅛-in.	39.8
⅛-in. to 1/16-in.	39.0
1/16-in. to 1/32-in.	35.5
1/32-in. to 1/50-in.	34.5
Pit sand all passing ¼-in., retained on 1/50-in.	30.2 to 23.3
Broken granite passing ⅜-in., and retained on ¼-in.	47.6 to 32.3
10 parts broken granite, all passing ¾-in. and retained on ¼-in., and 5 parts Leighton Buzzard sand, all passing ¼-in.	22.6

PALMERSTON WATERWORKS*

By A. E. Davison
Manager Municipal Department, Ontario Hydro-Electric Power Commission

ORIGINALLY the town of Palmerston, Ontario, obtained its water supply by means of air-lift pumping from two 8-inch wells, but the quantity thus raised became inadequate to serve the growing needs and during the first half of 1916, the local authorities consulted the Hydro-Electric Power Commission of Ontario on the subject of increasing the supply.

Several schemes were thought of, the two chief ones being as follows:—

1. To install a deep well pump.
2. To install a centrifugal pump.

The first was abandoned, since it was found that in order to obtain the 300 or 400 Imperial gallons per minute required, a 12-inch well would be necessary, and this meant boring a new well, which it was desired to avoid.

The second presented the difficulty that careful estimates based on the data at hand showed that the water level, when the required quantity of water was being pumped, would be about 40 feet below the surface of the ground, and as a centrifugal pump does not work satisfactorily with more than about 18 feet of suction, the use of such a pump would involve the sinking of a caisson around the well large enough to accommodate the pump and motor.

It appeared, however, that this scheme might be feasible, although it was realized that trouble would be encountered owing to the presence of quicksand some distance below ground level.

Finally a recommendation was made to the local authorities that a caisson around one of the wells be sunk about 30 feet deep and 8 feet in diameter and that in it should be suspended a vertical pump and motor, the pump to be at the bottom of the caisson and the motor near the top.

The local Water and Light Commission having given the Hydro-Electric Power Commission authority to proceed on this basis, plans and specifications covering the requirements were issued and tenders were obtained, the contract for the pump and motor going to the Canadian Fairbanks-Morse Company, Limited. The pumping equipment comprised the following:—

(a) One 4-inch, 2-stage, vertical centrifugal pump, capable of delivering 400 Imperial gallons per minute of clean, fresh water against a total head of 125 feet, with a guaranteed efficiency of 55 per cent., the speed being 1,435 revolutions per minute.

(b) One 30-h.p., 3-phase, 25-cycle, 550-volt, vertical, squirrel-cage, moisture-proof, induction motor, having a guaranteed efficiency of 87 per cent. at full load.

(c) Vertical steel framework, steady bearings, ball-thrust bearings, etc.

The work of excavating and making the caisson was undertaken by the town with the advice of the commission, a wood lining at first being tried; owing, however, to difficulties due to quicksand and the presence of some large boulders, as the work proceeded downwards the commission's engineers recommended a steel caisson, specifications for which were issued. This steel caisson was purchased from the National Equipment Company, of Toronto, and as soon as it was received the work was continued to a successful conclusion, though not without further difficulties due to quicksand being met.

The pump and motor, having passed the tests at the maker's works, were shortly afterwards installed and started up. A few minor troubles were experienced at that stage but were very soon set right and the equipment has now been operating quite satisfactorily since the first two or three weeks after installation—a period of some twelve months.

A small housing has been built over the caisson and electric lamps illuminate the interior. In order to install this equipment, the air-lift pumping plant at one of the wells has, of course, been dismantled, but the other remains intact for use in emergencies.

A very slight seepage of water into the caisson takes place, and to deal with this, a small gear pump has been installed; but it is only operated infrequently.

The entire cost of the work, including the surmounting of the troubles experienced with the quicksand, was approximately $3,400. As showing the financial advantage of having carried out this work, it may be said that information received from Palmerston indicates that whereas formerly the cost of coal for pumping was some 720 tons per annum at $4.45 per ton ($3,204), the cost for electric current is now about $876 plus 12 tons of coal at $10.50 (this price for coal seems high but does not seriously affect the saving of $2,200 shown if reduced to the figure used below, *viz.*, $7) which represents a saving of $2,200 per annum in operation alone. It may safely be added that there is no increase in any other costs, such as labor or repairs, tending to offset this favorable result.

The saving as above does not represent the true state of affairs for 1917, since, had the old method of pumping been in use, the gain would have been about as follows:—

720 tons of coal at $7 per ton = $5,040; while for electricity, assuming coal at the same price (*viz.*, $7 per ton) the cost would be $876 plus $84 = $960, showing a saving of over $4,000 for the year.

*From the Bulletin of the Ontario Hydro-Electric Power Commission.

Among the Canadian patents recently issued through the agency of Ridout and Maybee, Toronto, are the following: H. E. Angold and Wm. Duddell, distance operated mechanisms, and signals connected to electric supply systems; Henry P. Baird, air moistening and filtering attachment for radiators; G. and J. Weir, Limited, control device for rotary pumps.